ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST, PROPRIETOR.

SATURDAY, OCT. 8, 1881.

THE decrease of the national debt in the last three months has been $41,742,886.

THE second cable of Mr. Gould's company will be completed about the 10th inst. The stock has advanced, the last quoted premium being 52 per cent.

HIGHER prices for wheat, corn, cotton, petroleum, metals and merchandise, and the great speculation in those products have increased the demand for money. Increase of population continues and the expansion of business may sustain this demand for an indefinite period.

WE have received for suffering Michigan surveyors, donations of cash, drawing instruments and materials, which will be forwarded to Mr. Sherman at once. We hope the appeal published in last week's NEWS will be widely read and promptly acted upon. There will be need for all that is contributed.

THE BALDWIN LOCOMOTIVE WORKS.

The Messrs. Lippincott & Co., of Philadelphia, have lately published a very complete and handsomely illustrated catalogue of the manufactures of the above establishment, which, to persons who are interested in locomotive engines, must prove of very great practical value. Two-thirds of the book is taken up with photographic illustrations, with tables of reference and records of performances of Baldwin engines. The first sixty pages are devoted to a sketch of the works, from which we have abstracted a few of the more interesting features.

The founder of the establishment, Mr. Matthias W. Baldwin, commenced his business career as a jeweler, but in 1825 changed to that of a manufacturer of bookbinders' tools and cylinders for calico-printing, in which business he succeeded so well that steam power becoming necessary a small steam engine was bought, which, in those early days of steam, proving unsatisfactory, the future locomotive builder displayed his genius by designing and constructing one for his special requirements.

This first attempt at steam engineering was a great success, and the manufacture of stationary steam engines became a leading feature of the establishment. In 1830 steam as a motive power on railroads attracted the attention of American engineers, and Mr. Baldwin was employed to construct such a locomotive model as he could design from the information then obtainable, an undertaking which he completed in April, 1831, when the machine proved its efficiency by drawing two small cars, containing four passengers, on a circular track erected in the Philadelphia Museum. An order for a locomotive from a Philadelphia suburban railway company followed, and to prepare to execute this order Mr. Baldwin visited Bordentown to inspect a recently imported English engine, and with the memoranda there obtained set about the work. There were no competent mechanics, and there were very few proper tools, to be had in these early days. "Cylinders were bored by a chisel fixed in a block of wood and turned by hand. Blacksmiths able to weld a bar of iron exceeding 1¼ inches in thickness were few or not to be had. It was necessary for Mr. Baldwin to do much of the work with his own hands, to educate the workmen who assisted him, and to improvise tools for the various processes." But the "Old Ironsides," as this first Baldwin locomotive was named, was completed and tried on Nov. 23, 1832, and did duty thereafter on the Germantown road for over a score of years. It was an English four-wheeled engine of the "Planet" class, weighed a little over five tons; driving wheels, 54-in. diameter; cranks, 39 in., centre to centre; the front or carrying wheels, 45-in. diameter: cylinders, 9½-in. diameter, 18-in. stroke; wheels were cast-iron hubs, wooden spokes and rims, and wrought-iron tires; frame was of wood, placed outside the wheels; boilers, 30-in. diameter, containing 72 copper flues, 1½-in. diameter, and 7 ft. long; the tender was a wooden box on wheels, with an iron box for water, and a space in front for fuel; there was no cab; the price paid for it was $3,500; it ran on the trial at the rate of 28 miles per hour, and afterwards obtained, with its usual load, 30 miles per hour. The road had an ascending grade of 32 to 45 ft. per mile, which was found to be too heavy for such a light engine. Mr. Baldwin was so disgusted with his first locomotive, and accompanying difficulties of construction and settlement, that he remarked, with much decision, "That is our last locomotive."

But it was not, for in February, 1834, he completed his second, a six-wheeled engine, the 54-in. driving wheels of which were of solid bell-metal, the only instance in which that substance was used for the purpose. This engine weighed over seven tons. Five engines in all were completed in 1834, business was "booming," new shops were built on a portion of the site of the present works; new business connections were formed, many changes and several improvements were made and patented; there were numerous discouragements and some substantial rewards, until among the changes of partners, in 1842, Mr. Asa Whitney, then Superintendent of the Mohawk & Hudson Railway, was taken into the firm, which continued as Baldwin & Whitney until 1846, when the latter withdrew to go into the manufacture of car wheels, establishing the firm of A. Whitney & Sons, Philadelphia.

Mr. Whitney brought to the firm a railroad experience and thorough business talent. He introduced a system in many details of the management of the business which Mr. Baldwin, whose mind was devoted more exclusively to mechanical subjects, had failed to establish, or wholly ignored. The method at p esent in use in the establishment of giving to each class of locomotive a distinctive designation, composed of a number and a letter, originated with Mr. Whitney. Locomotives with one pair of driving-wheels were designated B engines; two pair, C; three pair, D, and those with four E; then a number was added to indicate the weight so that a 12 D engine is one with three pair of driving-wheels, and weighing 12 gross tons. The letter A was reserved for an engine that was never built.

At the beginning of 1854 Mr. Mathew Baird, who had been a foreman in the works from 1836, became a partner, and the firm was called M. W. Baldwin & Co.

The first coal-burners built by Mr. Baldwin were completed in 1847, but it was not for several years thereafter that the use of coal as a fuel for locomotives had become a practical success.

Steel tires in the driving-wheels of locomotives were first used in these works in 1862, on some engines for the Dom Pedro Railway, of Brazil. Their general adoption on American railways followed slowly, on account of their having all to be imported, and, in case of breakage, serious delay was the result, an engine with a broken tire being laid up for several months. To obviate this, M. W. Baldwin & Co. imported 500 tires, and so always had them in stock.

As early as 1839, Mr. Baldwin felt the importance of making all like parts of similar engines absolutely uniform and interchangeable. "In 1861 a beginning was made of organizing all the departments of manufacture upon this basis, and from it has grown an elaborate and perfected system, embracing all the essential details of construction. An independent department of the works having a separate foreman and an adequate force of skilled workmen, with special tools adapted to the purpose, is organized as the Department of Standard Gauges. A system of standard gauges and templets for every description of work to be done is made and kept by this department. The orginal templets are kept as "standards," and are never used in the work itself, but from them exact duplicates are made, which are issued to the foremen of the various departments and to which all work is required to conform. The working gauges are compared with the standards at regular intervals, and absolute uniformity is thus maintained. The system is carried into every possible important detail. Frames are planed and slotted to gauges, and drilled to steel bushed templets. Cylinders are bored and planed, and steam-ports, with valves and steam-chests, finished and fitted to gauges. Tires are bored, centers turned, axles finished, and cross-heads, guides, guide-bearers, pistons, connecting and parallel-rods planed, slotted, or finished by the same method. Every bolt about the engine is made to a gauge, and every hole drilled and reamed to a templet. The result of the system is an absolute uniformity and interchangeableness of parts on engines of the same class, insuring to the purchaser the minimum cost of repairs, and rendering possible by the application of this method, the large production which these works have accomplished."

Mr. Baldwin died Sept. 7, 1866, and in 1867 the business was reorganized under the title of "The Baldwin Locomotive Works." (Mr. Baird having sold his interest in 1873). The members of the firm are now Messrs. George Burnham, Chas. T. Parry, Edward H. Williams, William P. Henszey, Edward Longstreth and John H. Converse. The five-thousandth locomotive was completed April, 1880; it was designed for fast-passenger service on the Bound Brook Line, between New York and Philadelphia, and to run with a light train at a speed of 60 miles per hour. Its cylinders were 18 by 24, one pair of driving-wheels 6½ feet diameter, and a pair of trailing-wheels 45 inches diameter; its adhesion could be varied between the limits of 35,000 to 45,000 pounds on the single pair of driving-wheels; the total weight was 84,000 pounds.

"The capacity of the Baldwin Locomotive Works is ten locomotives per day; the maximum force employed is 3,000 men when the works are at their fullest capacity; all parts of the locomotives and tenders, except the boiler and tank plates, the steel tires and steel forgings, chilled wheels, boiler tubes, and some of the furniture, are made in the works from the raw materials. The plant comprises 734 machine tools, many of them designed and constructed to meet the special requirements of locomotive work. Drawings and patterns for over 500 different sizes or patterns of locomotives for all existing gauges and every description of service are included in the working lists."

The Messrs. Lippincott have shown great enterprise in producing so beautiful and comprehensive a book, which must inevitably find its way to the library of every engineer who has any interest in the subject of locomotives.

BOSTON PUBLIC WORKS.

The finance committee last week reported orders authorizing the city treasurer to borrow $1,450,000 for the general park scheme, $645,000 for street improvements, $936,000 for a new bridge to Charlestown and $400,000 to widen the Warren bridge.

PERSONAL.

The Geological Congress met in Bologna, Italy, on Tuesday of last week.

Estimates for new work proposed the current year by the Lighthouse Board, and for maintenance service, amounts to about $3,000,000.

The smallest engine in the world has just been finished in Baltimore. It can be covered with a thimble. Three drops of water will fill the boiler.

E. R. Howe has been appointed resident engineer on the Denver & New Orleans Railroad, with headquarters at Randall's Ranch, near Colorado Springs, Col.

The contract was awarded at the Treasury Department, for lathing the custom-house at St. Louis, to Dwight & Hoyt, of Springfield, Mass., for $32,800.

Chas. Webb Howard, President of the Spring Valley Water Co., of San Francisco, was in this city during the week, on business connected with the water supply of San Francisco.

An ingenious clock set up at Brussels needs no winding and attains the maximum of regularity by a simple mechanism. It is kept in motion by a current of air.

Alex. Siemens, C. E., of Siemens Brothers, electric cable manufacturers, of London, England, was married at Halifax on the 5th to a daughter of the Rev. George B. Dodwell.

The Mexican government has contracted with Mier, Celes & Co. for the drainage of the valley and city of Mexico for $9,000,000. The company is composed entirely of Mexicans.

Mr. B. V. Enos, a well-known architect of Indianapolis, was married on Sunday last to Mrs. Matilda J. Norris, of Shelby County, reported to be one of the handsome and wealthy women of that shrievalty.

The terribly windy stretch of the St. Gothard tunnel under Andermatt is still giving the engineers trouble, and the opening of the tunnel for regular postal traffic, which was expected to take place this month, is put off to Jan. 1.

Count Von Moltke has given a favorable opinion about the newly planned channel by which the North Sea is to be joined to the Baltic, and the government will probably soon ask the House of Deputies to vote the necessary funds for this great work.

The favorite East Indian summer retreat, Naini Tal, is not yet considered safe from a repetition of the terrible land slip of last year. The Municipal Committee have applied to the Indian government for a loan for the purpose of protecting the dangerous portion of the district.

At Pembroke College, Cambridge, has been brought to light the solid silver mitre and crozier which belonged to Bishop Wren, the uncle of Sir Christopher Wren, the architect of St. Paul's. Bishop Wren was successively Bishop of Hereford, of Norwich, and of Ely.

H. M. Redington, of Elyria, O., engaged in the survey of a new route from Denver to Leadville, for the Denver & Rio Grande Railroad Company, under Chief Engineer H. C. Smith, was killed on the 29th ult. by falling from a rocky cliff. His remains were brought back to Elyria.

The number of original patents issued the first nine months of the present year is 14,084, an increase of 2,261 over last year. Receipts of office for the same period, $65,447 in excess of the corresponding nine months of 1880. The Commissioner of Patents recommends considerable increase in the examining corps and clerical force.

Mr. Jas. W. Morris has been appointed Chief Engineer of the Peoria, Decatur & Evansville Railway Co., with office at Mattoon. He will have full charge of maintenance of road-bed, bridges and buildings, and will be respected and obeyed accordingly. Signed, Geo. L. Bradbury, General Manager.

F. W. Vaughan, Esq., has been appointed Consulting Engineer of the Henderson Bridge Company, with headquarters at Louisville, Ky. All employés in the engineering department of that company will respect and obey his orders. Signed, F. de Funiak, General Manager L. & N. R. R. and Chief Engineer Henderson Bridge Co.

Mr. C. A. Allen, the very popular City Engineer of Worcester, Mass., has been spending a few days in the city on business connected with his office. Mr. Allen has held his important position for several successive years by unanimous reappointment, and, like the well-governed city of Providence, R. I., Worcester finds it to its advantage, when it has a good servant, to make the most of him by adding to his responsibilities.

In the reading-room of the municipal library of Rouen, in France, has been set up a curious and ancient clock. It was built originally in 1782; in 1816 it was altered; in 1838 it was bought by Rouen for 1,000f., and, after being for some years in disuse, it has now been repaired and set going. The hour and the day of the month are shown by it, and it will go for 14 months and several days, after a single winding.

A neat little volume of 64 pages on "The Treatment of Steel," has been issued by Miller, Metcalf & Parkin, of Pittsburgh, embodying a series of circulars on heating, annealing, forging and tempering. It is handsomely illustrated, and the information it contains will be appreciated by the manufacturers and users of the product in its diversities of quality, treatment and management.

President Gillman, of the Johns Hopkins University, defines a university as a society of masters and scholars—"an association by authority of masters who are conspicuous in ability and learning and devotion to study, for the intellectual guidance in many subjects of youthful scholars, who have been prepared for the freedom of investigation by prolonged discipline in literature and science." This institution is expecting a visit from Professor Cayley, of Cambridge University (Eng.), who will take part in the mathematical instruction at Johns Hopkins during the ensuing year.

Mr. Rudolph Hering, Assistant City Engineer-in-Charge of the Sewerage of Philadelphia, was in this city on Wednesday. Mr. Hering is very busily engaged in preparing his Report on Sewerage matters, for which he was sent to Europe last year by the city of Philadelphia and the National Board of Health. When completed this report will undoubtedly embody the most recent information on the subject of sewerage systems and sewage disposal that is obtainable, as Mr. Hering, while in Europe, had exceptional facilities granted him for investigating, and his long, practical experience with the sewerage of Philadelphia has well fitted him to appreciate and point out the most valuable features of the now important problem of how best to make our cities healthy places to live in.

Mr. Benjamin Rhodes, of Niagara Falls, engineer of the upper suspension bridge at the Falls, and whose kind courtesies to visiting members, in June last, will be long remembered by their recipients, is in this city for a few days and was present at the Society meeting on Wednesday evening. Mr. Rhodes has for a year or more been investigating and experimenting on the feasibility of using some of the wasted power at the Falls for the purpose of electric lighting. A circuit of four miles is already in successful operation and Mr. Rhodes is now endeavoring to test one of twenty miles to see if it is not possible to light, say Buffalo, with electricity generated at the great cataract. Mr. Rhodes has been interviewing the electric light companies and the future will probably develop the result of his efforts.

We learn that Mr. P. A. Peterson, Chief Engineer of the Western Division of the Q., M., O. & O. Railway has resigned his position in order to accept that of Chief Engineer of the new bridge about to be constructed across the St. Lawrence, west of the Victoria Bridge, by the Atlantic & Northwestern Railway Company. We understand that the work of construction in connection with this bridge will be commenced as soon as the necessary plans have been prepared, and that Mr. Peterson enters upon the work of preparing them at once. The Atlantic & Northwestern have been singularly fortunate in the selection of an engineer. The character of the bridges and roadway on the Q., M., O. & O. attest the skill and devotion of Mr. Peterson in any work with which he is intrusted. Both the company and their chief engineer have our warmest congratulations.

The English language on the tongue of a man who wishes to express a strong feeling or conviction has vast capabilities. When that animated corkscrew commonly called a reporter asked Mr. Field the other day what his opinion was of the certificates which the Manhattan Company desires to issue in payment of their debts, the man of finance replied that he wouldn't give a dollar for as many of them "as a jackass could draw down hill." What a limitless sense of worthlessness the words convey. They are as expressive as the language of the farmer in old colonial times who said that he would sell wood for the paper currency then extant, but it must be "cord for cord." If Mr. Field had declared that he wouldn't give a dollar for as many certificates as a jackass could draw up hill he would have given one a far-off suggestion, a vague and indefinite sense of infinitesimal value; but alas! for the worth of paper when as much of it as will roll down hill of itself and push a donkey in front of it is not worth a dollar.

Fletcher Urling Harper, a grandson of Fletcher Harper of the original four brothers of the firm of Harper & Brothers, died on the 4th at the residence of his father-in-law, ex-Senator Alexander McDonald, 61 West Forty-eighth street. His father is Joseph W. Harper, 2d, who now resides in Europe. Mr. Harper was born in this city on Aug. 15, 1848. He was educated at the Moravian Academy, Nazareth Hall, Nazareth, Pa., and subsequently at Frankfort, Germany, and Fay's Institute, Newport, R. I. He was afterward in Europe for a year, and in 1870 he came to this city and entered the publishing house. He was put to work at a compositor's case for eighteen months, after which he took a responsible position in the counting-house. In 1872 he married Miss Tacie B. McDonald, a daughter of the ex-Senator. In 1877 he had an almost fatal attack of diphtheria, which left him greatly enfeebled. Last week, when at Richfield Springs, he suffered an attack of paralysis. He was brought to this city in an unconscious condition, and died without regaining consciousness. His wife and three small children are living.

The Trustees of the Johns Hopkins University call particular attention to the opportunites which are offered in Baltimore, during the academic year, 1881-82, for the prosecution of advanced studies in various branches of Pure and Applied Mathematics and in Physics. An invitation has been extended through Professor Sylvester to Professor A. Cayley, D. C. L., LL D., F. R. S., Sadlerian Professor of Pure Mathematics in the University of Cambridge (England), to visit Baltimore and take part in the mathematical instruction of the Johns Hopkins

University during the ensuing academic year. Professor Cayley has accepted this invitation—subject to the approval of the authorities of his own university; and it is expected that he will arrive in this country before the 1st of January next, and take a regular part in the instruction of the Johns Hopkins University from that time until the close of the session in June. Besides giving lectures to mathematicians, he will, like Professor Sylvester, take part in the Mathematical Seminary and be accessible to advanced students who desire to consult him in the progress of their work. A more particular statement in regard to his lectures may be expected at a later day.

The leading builders of small steam craft in this country are the Herreshoff Brothers, of Bristol, R. I. They make vidette and torpedo boats, steam launches and yachts, and so great is the demand for their swift-sailing craft by Europeans that at present writing the works are run to their fullest capacity. But one of the most remarkable things in connection with the firm is that the principal inventor of the firm, Mr. James Brown Herreshoff, lost his sight at fifteen and since then has been stone blind. Yet with this almost insuperable drawback to success, the Herreshoff Brothers have beaten the world in their specialty. Fifteen to twenty-three knots per hour is the usual rate of speed of those little steamers. Referring to his blindness, a United States naval officer remarked: "If you saw Mr. James Herreshoff on board of one of his launches when she was going, you never could imagine but that he was endowed with sight. Once he gets his proper bearings near the engine, though it may be clattering along with the greatest rapidity, his hand and fingers touch every part while it is in motion, and you forget, such is his certainty, that the slightest mistake might endanger his hand. The perceptive faculties are at their extremest point of education. Though he is stone blind, Mr. James Brown Herreshoff appreciates every single portion of his engine, and in his mind knows the exact relation of every part to the other." While in England, this same gifted man is said to have steered his own boat on some of her trials. Imagine something of this kind. This little vessel driven at her utmost speed right up to a heavy stone quay. One foot more and she will crash against this obstacle and cave in her bow. But with a turn of a lever in a twinkling Mr. Herreshoff reverses the engine and she backs again unharmed. With a sense of distance, that thorough acquaintance of time which only a metronome could impart, he has estimated every pulsation of the steam exhaust—the exact revolutions of the rapidly whirling screw—and the little craft is as safely handled as if she were in charge of a pilot who had the sharpest, keenest eyes. Facts like these, of a man's triumph over physical misfortune, must bring their consolation to the unfortunate, and even this might be deduced, that from the brain alone is derived that greater power which achieves success.

The growth of telegraphy has been something even beyond the marvelous. The first line was erected only thirty-seven years ago, and now in the United States alone 250,000 miles of wire are in constant use, and the Mutual Union will soon add another 100,000 miles. Great Britain has 114,000 miles, Germany 150,000, with 3,000 more under ground; France has 115,000 miles, British India 50,000, Belgium 15,000, Spain 35,000, Denmark 61,000, Norway 10,000, China 1,200, Egypt 9,000, Persia 6,000, Russia 130,000, Australia 15,000, including a line of 2,000 miles running through an almost unknown region of the island, and New Zealand has 10,000 miles, Mexico has 7,000 miles, and Canada 25,000. The length of the submarine cables is estimated at 104,000 nautical miles. With the exception of Great Britain and Germany, the Morse system is used everywhere.

JOHN ERICSSON—SOME OF HIS WORKS.

John Ericsson was born at Langbanshyttan, Central Sweden, on July 31, 1803. His father, Olof Ericsson, was a Swedish miner in the iron mines situated in the province of Wermland, midway between the capitals of Sweden and Norway. In the midst of the hard, practical life of his people, and surrounded by the noise of rude machinery, miniature models of which he amused himself by building, were passed the first few years of Ericsson's life. In 1813 he had constructed a saw-mill after designs of his own, and had planned pumping machinery for clearing the mines of water. The only tools he had for this work were a file to cut the saw teeth, a gimlet and a jacknife.

During the previous year an acquaintance had been made with the use of drawing instruments in one of the engineers' offices of the great ship canal of his native country. The removal of his father to the depths of a pine forest compelled the boy to make his own tools; compasses of birch wood, with needles inserted for points; a pair of steel tweezers obtained from his mother were transformed into a drawing pen; some hair taken from her sable cloak became two brushes with which to apply the coloring which was then deemed necessary in all mechanical drawings. The power to work the pumping engine was to be furnished by a wind-mill, and it was here that the youthful inventor met with some difficulty, as he had never seen one in operation, and could only guess at its construction from the descriptions of those who had. He drew plans of mechanism connecting the crank of the wind-mill shaft with the pump levers, but was puzzled how to arrange the mill so that it would turn with the wind. About this time his father made a visit to a mill, and upon his return made mention of a "ball and socket joint." With this hint the young draughtsman rushed to his table and had soon inserted a ball and socket joint where the connecting rod joined the pump-lever. This work, conceived and executed under such adverse circumstances, attracted the attention of Admiral Count Platen, the President of the Gotha ship canal, on which Ericsson's father was employed, and one of the great men of Sweden.

When twelve years old Ericsson was appointed a cadet in the Swedish corps of Mechanical Engineers, was soon promoted to leveler, and when thirteen years old had charge of a section of Count Platen's ship canal, with six hundred of the royal troops looking to him for the daily direction of their work. An attendant bearing a stool always followed him, in order that he might raise himself to the height of his instruments.

At the age of fifteen he had a portfolio of drawings, made during leisure hours, showing 300 miles of the grand canal and all the machinery used in its construction. This canal extends across Sweden from the Baltic to the North Sea, and many important works upon it were made from Ericsson's drawings of that time. In 1815 he made the drawings for the great Sunderland iron bridge.

Ericsson relinquished the position as engineer on the Gotha canal to join the Swedish army, from which service he derived his title of "Captain." Soon after, the appointments of government surveyors being offered by competitive examination, he hastened to Stockholm, and, aided by his experience on the canals, easily obtained a prize. Although his labors at this time were extremely arduous he sought an outlet for his superfluous energy by drawing and engraving sixty-four large plates for a work illustrating the Gotha canal. By bringing his inventive faculties into play he constructed a machine engraver, with which he made eighteen copper plates, each of three hundred square inches, within a year.

From engraving he turned his attention to experiments with flame as a means of developing mechanical power, and from encouragement received from his superior officer invented a flame engine and built one of ten-horse power. In order to obtain a larger field for his operations, he obtained leave of absence and visited England in 1826. After a short residence in that country he sent in his resignation, which was reluctantly accepted, but not until he had received his promotion to a captaincy.

He was not successful in introducing his engine, as the sea-coal of England produced so intense a heat as to destroy its working parts, and he was compelled to undertake a new series of experiments. The result was an engine which was patented and sold to John Braithwaite. The records of the London Patent Office show that during his residence of thirteen years he obtained patents for a pumping engine on a new principle; engines with surface condensers and no smoke-stack, blowers supplying the draught, used on the steamship Victory in 1828; an engine consisting of a hollow drum rotated by the admission of steam, and which continued to rotate for some hours after the steam had been shut off, the circumference moving at the rate of nine hundred feet per second; an apparatus for making salt from brine; machinery for moving boats on canals; a variety of motors actuated by steam or hot air; an hydrostatic weighing machine, for which the Society of Arts awarded a prize; an instrument for taking soundings independently of the length of lead line; a file-cutting machine; and many others, which show the depth of his research and universality of his inventive powers.

The principle of the condensing steam engine was first used on the Victory, and in the vessel Corsair, built at Liverpool in 1832, were first used the centrifugal fan blowers, now so general in most of the steamships of this country. Superheated steam was used in an engine built by Ericsson, on the Regent's Canal Basin, in 1834, and in the King William and Adelaide locomotives, in 1830, the link motion was first used—the Stephenson link being a modification of this. At this time he built a locomotive in which he introduced an artificial draft.

The Liverpool & Manchester Railroad, in 1829, offered a prize for the best locomotive—traction power and a speed of ten miles an hour being the most important tests. The London *Times* of Oct. 8, 1829, states that the speed of the three competing engines was "far exceeded by that of Messrs. Braithwaite & Ericsson." It further records that this engine—the Novelty—"was the lightest and most elegant carriage on the road yesterday, and the velocity with which it moved surprised and amazed every beholder. It shot along the line at the amazing rate of *thirty* miles an hour. It seemed to fly, presenting one of the most sublime spectacles of human ingenuity and human daring the world ever beheld."

The Rocket—built by Robert Stephenson, after plans by his father George—weighed four tons and three hundred weight, and drew seventeen tons at the rate of thirteen and one-half miles per hour for seventy miles. Ericsson's weighed two tons and fifteen hundred weight. It was not until seven weeks before the trial that Ericsson became aware that a prize had been offered, and yet his locomotive was promptly on hand.

He now built a steam fire engine, which did valuable work at the burning of the Argyle Rooms in 1829; he built a larger one for the King of Prussia for service in Berlin; and a third, in 1830, for the Liverpool Docks. In 1840 the Mechanics' Institute of this city gave its gold medal to Ericsson for the best plan of a steam fire engine.

In attempting to find a substitute for steam, in artificial heat, he studied the problem of the utilization of the great dynamic force of the sun's rays, over that portion of the earth's surface where the use of steam is precluded by the want of both fuel

and water. Ericsson states: "There is a rainless region extending from the northwestern coast of Africa to Mongolia, 9,000 miles in length, and nearly 1,000 miles wide. Besides the North African deserts, this region includes the southern coast of the Mediterranean, east of the Gulf of Cabes, Upper Egypt, the eastern and part of the western coast of the Red Sea, part of Syria, the eastern part of the countries watered by the Euphrates and Tigris, Eastern Arabia, the greater part of Persia, the extreme western part of China, Thibet, and lastly, Mongolia. In the western hemisphere, Lower California, the table-land of Mexico and Guatemala, and the west coast of South America, for a distance of more than 2,000 miles, suffer from continuous radiant heat." To utilize this great energy Ericsson is mainly devoting his remaining years.

Studying the movements of birds and fishes, Ericsson became convinced that the principle of rapid motion was in oblique action, and the first fruit of this belief was the screw propeller. Although there has been much dispute regarding this invention, the honor of its introduction and practical utilization is undoubtedly due to him. In 1839 his propeller, the Francis B. Ogden, towed the British Admiralty barge on the Thames. His vessel was eighty feet in length and forty feet beam, three feet draught and was furnished with two screws, each five feet three inches in diameter. This practical demonstration of its power failed to convince the Admiralty, and resulted in Ericsson's leaving England for America in 1837. Through the efforts of Captain Robert F. Stockton, of the United States Navy, who had ordered two vessels similar to the Ogden, and after a delay of two years the authorities at Washington gave Ericsson an order to build a trial boat, and in 1844 the Princeton was completed. The lamentable disaster caused by the bursting of the great gun, the "Peacemaker," on the Princeton at the time of its public exhibition, is too well known to need a description here.

The revolution in naval engineering caused by the little Monitor in Hampton Roads is well known; the incident forms one of the most important events during the last war. Sweden, Norway and Russia immediately adopted the plan of the Monitor for its war vessels, but England failed to grasp the idea until the appearance of the double turreted vessel—Miantonomah—in English waters in 1866.

Captain Ericsson, having introduced a new system of naval architecture, is now devoting a por-

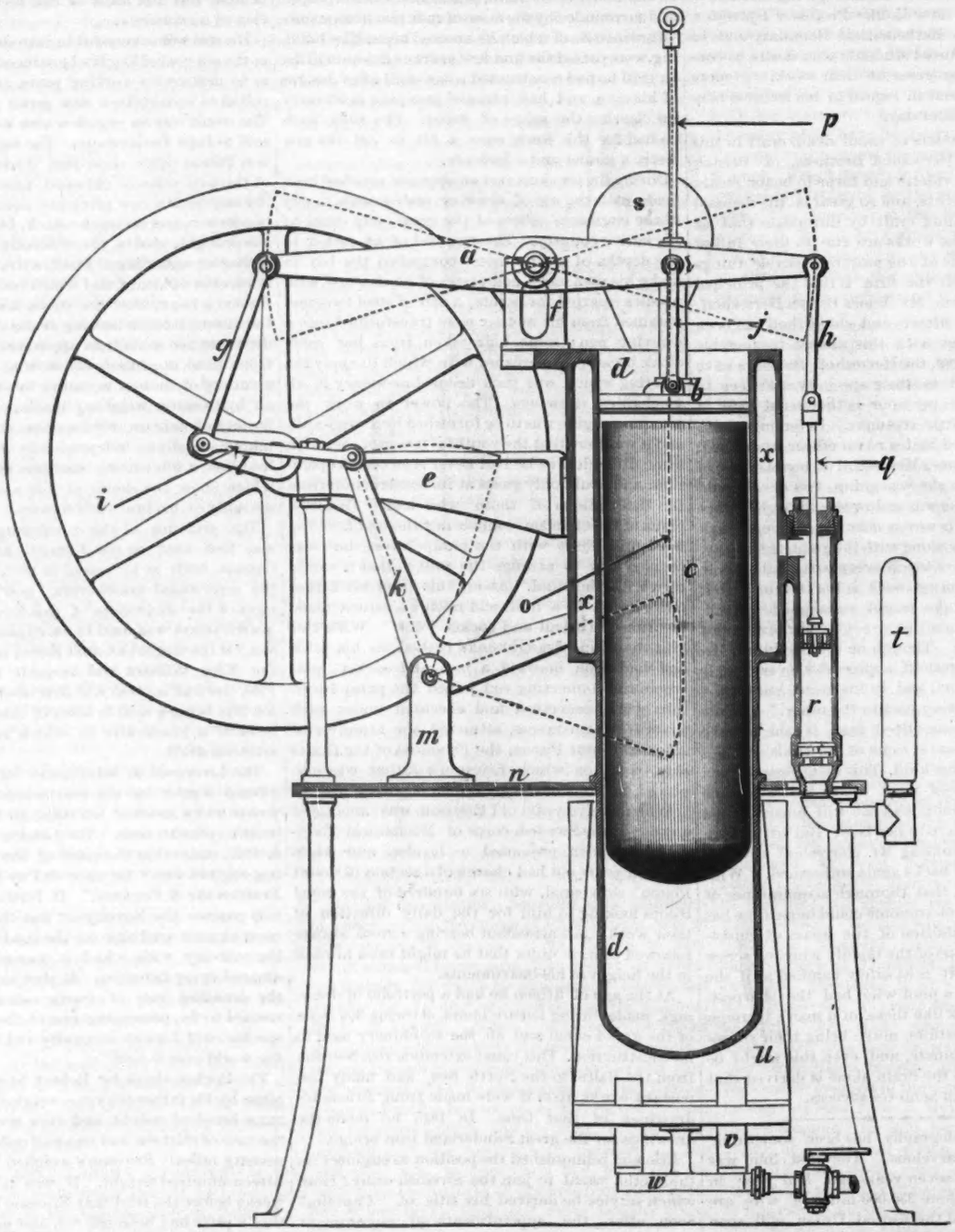


FIG. I.—ERICSSON CALORIC ENGINE.

tion of his time to a system of submarine attack.

THE CALORIC ENGINE.

Ericsson, in 1833, first introduced a caloric engine to public notice. In these studies he has endeavored to practically develop the theory that heat as an agent suffers no change, and that in developing mechanical energy, but a small portion of its initial power is lost. He constructed a working model of a five horse-power engine, which at first received the sanction of Faraday, Dr. Andrew Ure, and others. Difficulties mainly relating to durability coming up he ceased work in this direction until his removal

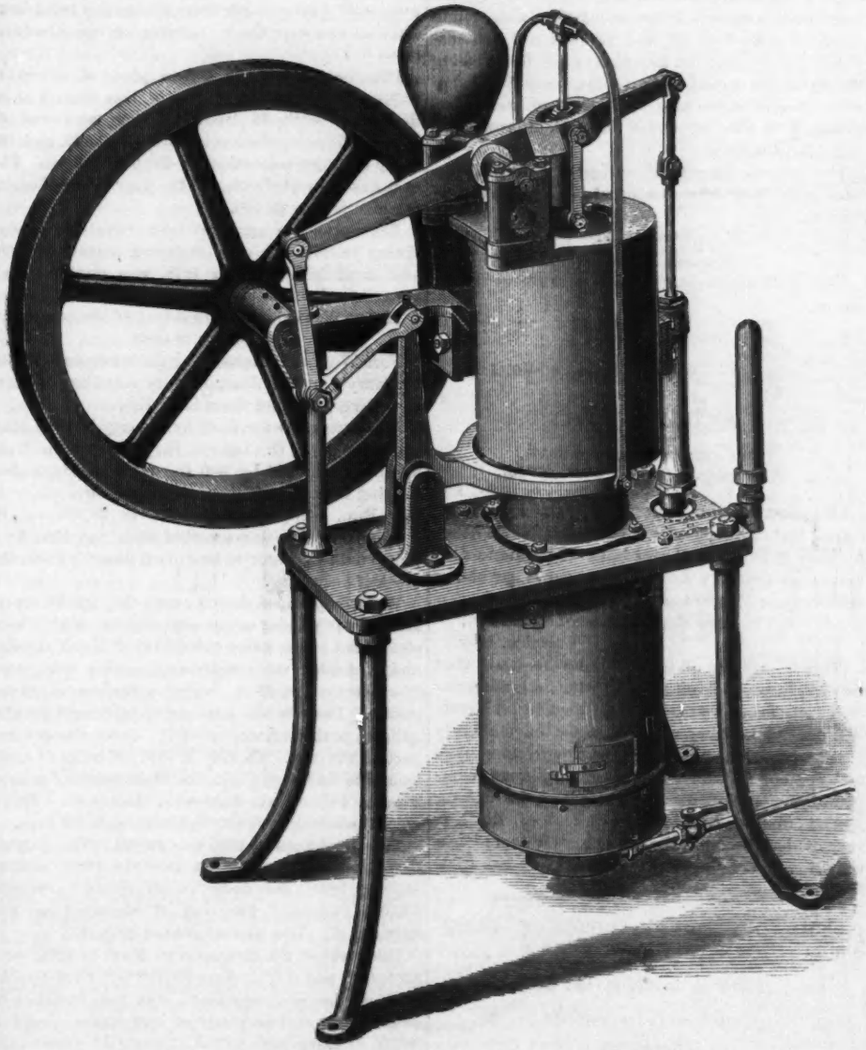


FIG 2.—ERICSSON CALORIC ENGINE.

to this country, when his labors toward perfection were renewed. Several caloric engines were then built, each larger than its predecessor, and in 1851 the ship Ericsson, of two hundred and sixty feet in length, was constructed and fitted with caloric engines. In regard to this experiment Ericsson says: "The ship after completion made a successful trip from New York to Washington and back during the winter season; but the average speed at sea proving insufficient for commercial purposes, the owners, with regret, acceded to my proposition to remove the costly machinery, although it had proved perfect as a mechanical combination. The resources of modern engineering having been exhausted in producing the motors of the caloric ship, the important question has forever been set at rest, can heated air, as a mechanical motor, compete on a large scale with steam? The commercial world is indebted to American enterprise—to New York enterprise—for having settled a question of such vital importance. The marine engineer has thus been encouraged to renew his efforts to perfect the steam engine without fear of rivalry from a motor depending on the dilation of atmospheric air by heat."

Although Ericsson withheld from further attempts upon such a large scale, he produced caloric engines of great utility for the production of a smaller power. In 1862, the American Academy of Arts and Sciences passed the following: "Voted, that the Rumford premium be awarded to John Ericsson for his improvement in the management of heat, particularly as shown in his caloric engine of 1858."

As a result of years of labor and thought by the man who for more than half a century has been at the head of his profession, we present a perspective and sectional view of his present perfected caloric engine, now being manufactured at the Delamater Iron Works, office No. 10 Courtlandt street, this city.

The sectional view, fig. 1, shows the engine and pump complete, with the gas furnace, the action of the engine being to alternately heat and cool the air confined below the air piston in cylinder *d*, the heating of the air generating a pressure which acts on air-piston *b*, causing it to move through its upward stroke, actuating pump and fly-wheel by means of beam and links as shown, the momentum of fly-wheel and contraction of the air making the return stroke; the office of transfer piston *c*, by its movement derived from crank through link and bell crank, being to displace the air from the lower or heated part of the cylinder to the upper or cold part, and *vice versa*. The following are the various parts of the engine: *a*, beam; *b*, air piston; *c*, transfer piston; *d*, cylinder; *e*, fly-wheel bracket; *f*, beam center bearing; *g*, connecting rod; *h*, pump link; *i*, bell crank link; *j*, air piston link; *k*, bell crank; *l*, crank; *m*, bell crank bracket; *n*, table; *o*, side rods; *p*, transfer piston rod; *q*, pump rod; *r*, pump; *s*, air chamber; *t*, vacuum chamber; *u*, gas furnace; *v*, gas burners; *w*, gas chamber; *x*, water jacket.

The engine is specially intended for pumping water into tanks in dwellings, factories, railroad stations and similar works. It is noiseless in action, valveless, requires no attention and is absolutely safe, being used by many underwriters of this city. The size, 6-in. cylinder, will raise 200 gallons 50 ft.; 8-in. cylinder, 350 gallons 50 ft.; 12-in., 800 gallons 50 ft.; 16-in., 1,600 gallons 50 ft. The engines are constructed so as to burn either coal or gas, the consumption being as follows:

6-in. machine, 2½ lbs. anthracite nut coal per hour.

8-in. machine, 3⅓ lbs. anthracite nut coal per hour.

12-in. machine, 6 lbs. anthracite nut coal per hour.

16-in. machine, 12 lbs. anthracite nut coal per hour.

12-in. (duplex) machine, 12 lbs. anthracite nut coal per hour.

6-in. machine, 18 cubic feet of gas per hour.

8-in. machine, 25 cubic feet of gas per hour.

These engines may be applied to deep-well pumping, where the water is more than 25 ft. below the surface, by lowering the pump-cylinder down to the water, or down to within 8 or 12 in. of the bottom of the well is better, and connecting the pump with engine by iron pipes in short lengths, which may be screwed together as they are lowered down, it being unnecessary to go down in the well. The pump is simply screwed on end of pipe and lowered until it has reached the water, the pump-rod being also in convenient lengths and inside of pipe.

CORRESPONDENCE.

WIND PRESSURE.

CHIEF ENGINEER'S OFFICE C. & A. R. R.,
CHICAGO, Sept. 28, 1881.

EDITOR ENGINEERING NEWS:

Referring to the article written by Mr. Gottlieb, and published Sept. 17 in ENGINEERING NEWS, I beg space in the columns of your interesting paper for the following:

Instead of Mr. Gottlieb saying that at the time he wrote his discussion of Mr. C. Shaler Smith's article on Wind Strains, he did not know the method practiced in this office when treating of such stresses—he ought to have said that he had forgotten it. In October or November of last year Mr. Gottlieb called at our office, and at his request I had the pleasure of explaining the method to him in detail. Much to my gratification, he at that time spoke very highly of it to our Chief Engineer, Mr. Booth, and said that he would be in favor of adopting it, provided other bridge companies would do the same, all bids then being based on the same method of calculating the necessary material. I was, therefore, much surprised to learn that Mr. Gottlieb had so soon radically changed his mind.

If, as Mr. Gottlieb admits, our practice is not

wrong in principle, it must be right in principle, and the question is whether we shall or shall not adopt what is admitted to be right. With all respect to Mr. Gottlieb's method of guessing at required sections of "floor-beams, floor-beam hangers, and middle main ties" by adding from 10 per cent. to 100 per cent.—a rather wide range—to the sections found necessary from the action of dead and live loads, I must say I think that way of arriving at results is becoming rather old-fashioned. I believe that one step toward analyzing the heretofore unknown strains in a bridge is by properly treating the stresses due to wind. It is true that, as yet, but little is known of the exact effect on different members of the impact due to a rapidly moving train, but in the closer study and analysis of these forces and their effects lies a wide field for investigation. The nearer we can arrive at a knowledge of the exact stresses due to wind, impact, etc., the less guess-work there will be in proportioning the various members, and it may be that, when we know more about these stresses, we will find that the percentages of increase which Mr. Gottlieb says at the present time enter into "every properly constructed railroad bridge," are entirely too large, and that a total reduction in cost of such structures may be obtained; and if it is found that those percentages are too small, certainly in the interests of humanity they should be increased.

Mr. Gottlieb speaks of my having contempt for the factor of safety. On the contrary, I have so high a regard for it that I do not wish to place two burdens upon it—the one to overcome a known stress, that due to wind pressure, and the other all the unknown, uncertain stresses that may arise. The latter is all the duty I can consent to allow to it, and the narrower the circle of uncertainty can be drawn the better it will be.

The maximum effects in the members of both rolling load and wind pressure cannot be obtained at the same time, but Mr. Gottlieb's conclusion that, because these effects are inversely proportional, the smaller should be entirely neglected or merely guessed at does not follow. With the maximum effect from rolling load should be combined the stresses in the members due to wind pressure upon that rolling load. As to whether this effect of the wind on the maximum rolling load is worthy of notice is a matter of judgment, but in this office we find that firms offering bids consider it of enough importance to increase their prices from 10 per cent. to 15 per cent.

Either this increase in the cost of our bridges over the first bid submitted must be due to the extra material we have found necessary to put in to overcome the calculated wind stresses, or else Mr. Gottlieb must admit that in his case there was a failure in his first proposals to submit to us plans for "properly constructed" railroad bridges, containing the percentages of increase in the members which he considers necessary for "every properly constructed railroad bridge."

Mr. Gottlieb, in parenthesis, touches me on my use of the term, *factor of safety*. I think there has been altogether too much time and space lent to the petty discussion of whether we shall call that "what is it" "factor of safety," "factor of ignorance," or something else. To me, one name for it is as good as another, and I will acquiesce in the use of any that may be decided upon.

I do not believe that State street bridge has been loaded in excess of the moving load used in the alculations of the required areas of its web members.

The taking of the plane of x in my calculations on a level with the tops of the floor beams was an error in manuscript writing, and is not where I have been accustomed to place it. I have always in actual practice placed it on a level with the tops of the *stringers*.

Mr. Gottlieb's suggestion to place it at the top of the rail is good, and I accept it with thanks, but I will not admit that in any other respect the formula which he deduces is any "more accurate" than that given in my previous article, for by simple inspection each may be seen to be the same as the other under different forms.

Yours very truly, E. J. WARD

EARTHWORK CALCULATIONS.

MANSFIELD, La., Sept. 16, 1881.

To the Editor of the Railroad Gazette:

My "formula for toe of dump" in your issue of Sept. 2 [Page 378 *ante* ENGINEERING NEWS] was incorrect, because all my calculations then made were for a six-foot fill, and hence I did not sufficiently recognize the fact that as the fill increases the pyramids spread on two sides, while the wedge only spreads on one side. The ratio of content of pyramid to that of wedge depends on road-bed, slope ratio and fill.

The formula for cubical content of a railroad embankment from crown to toe of bank should be as follows:

Let W = cubical content of wedge.
S = slope ratio.
R = width of road-bed.

Then cubical content of section from crown to toe =

$$W+\left[W\times\frac{8\,S+6}{R}\right]$$

GEORGE BAYLEY WILLIAMS.

MEXICAN MAILS.

IN CAMP AT RANCHO NUEVO,
IN THE STATE OF SAN LUIS POTOSI,
MEXICO, Sept. 3, 1881.

DEAR SIR: Since coming to Mexico I have received just one copy of ENGINEERING NEWS—that for July 2, 18:1. Will you have the kindness to make sure that at your end the paper is regularly mailed to, Yours truly, FRED. BROOKS,
Asst. Eng. Mexican Central Ry.,
Tampico, Mex.

[This is only one of many similar requests that we have received from Mexico, where a large number of engineers are readers of ENGINEERING NEWS. We can do nothing more than we have already done, which is to be extra careful with our mails for Mexico, and on account of numerous complaints the post-office authorities here are making special efforts to trace out the difficulty. But it is very evident that the land of the "Greasers" is a very slippery region to do business in.—ED. ENG. NEWS.]

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 394.)

CIV.—ALTON.

Alton, Illinois, on the Mississippi River, is 4 miles above the mouth of the Missouri River and 25 miles north of St. Louis. Its length along the river is 2⅗ miles, average breadth 1½ miles. A little west of the centre it is divided by Pisa Creek. Each side of this valley, and up and down the river from it, the ground rises rapidly and in some places abruptly into irregular, broken bluffs, the highest being 224½ ft. The town was laid out in 1817.

In 1875 water-works were built by a private company after plans and under the superintendence of Harry Taylor, C. E., taking water from the Mississippi River.

Water is conducted from the river to the pump-well by a conduit of stone masonry in cement, 3 by 5 ft. It contains an iron box of 54 cu. ft. contents, perforated with holes and filled with sponge, through which the water is filtered. This box can be raised by means of a crane, and the sponges washed when full of silt. There are three sets in use, giving ample time for each set to dry and be aired. This arrangement has been found to work well.

A horizontal duplex, high pressure, fly-wheel, Dean engine and pump, with a capacity of 2,000,000 gallons in 24 hours, and an auxiliary Worthington engine and pump of 1,500,000 gallons capacity in 24 hours, force the water into two wooden tanks, set 30 ft. above ground and 260 ft. above the pumps, one 40 × 24 ft. and one 30 × 16 ft., with a capacity of 300,000 gallons. They are pumped full each afternoon, giving a pressure over the business portion of the city from 80 to 100 lbs., and over the remainder of the city from 50 to 75 lbs.

Distribution is by cast-iron pipe, of which 13 miles are now in use, none of less than 6 in. in diameter, with 95 hydrants, 160 taps and 50 meters. The population in 1880 was 9,500, and the daily average consumption 200,000 gallons. The cost has been $105,000, and the yearly cost of maintenance is now $3,600.

The works are managed by a private company. Harry Taylor was chief engineer of construction, and until his death, in 1878, was engineer and superintendent of the works.

Henry Watson is the president of the company.

CV.—FORT WAYNE.

Fort Wayne, Indiana, is at the confluence of the St. Mary's and St. Joseph rivers, forming the Maumee River, 94 miles from Lake Erie.

Water-works were built by the city in 1880, after the plans of J. D. Cook, C. E., taking water from an open basin 120 by 380 ft., excavated in water-bearing gravel 12 ft. below ordinary low water in Spy Run. The filtering area is 38,959 sq. ft.

The basin is also connected with Spy Run by a pipe, enabling water to be drawn directly from the creek if necessary.

Water is pumped directly into the mains by a Holly five-cylinder compound engine, with 19-in. steam and 11-in. water cylinders of 27-in. stroke, and a duplex non-condensing engine with two 18-in. steam and 10-in. water cylinders of 24-in. stroke. There is also a reservoir holding 3,500,000 gallons, with its flow-line 97 ft. above the central part of the city. To May 1, 1881, 26 miles of cast-iron pipe had been laid for distribution, nearly 2 miles being less than 6-in. diameter. There were then in use 206 fire hydrants and 200 taps.

The population in 1880 was 26,880. The engines began delivering water on Dec. 14, 1880, and to May 1, 1881, the daily consumption averaged 535,000 gallons. The cost of construction was $218,028.63. The bonded debt is $270,000.

The cost of maintenance to May 1, 1881, was $2,757.22, and the revenue $2,040.53. C. S. Brackenridge, the city engineer, was the engineer of construction. The clerk of the water board is W. E. McDermot.

CVI.—CONSHOHOCKEN.

Conshohocken, Pennsylvania, is on the Schuylkill River, 12 miles above Philadelphia.

In 1873, the population being about 4,000, water-works were constructed by a private company, after plans and under superintendence of Isaac Cassin, C. E.

Water is taken from the Schuylkill River, from the Plymouth dam, 12 miles above Philadelphia.

The water is pumped by a Worthington duplex engine, with two 20-in. steam and two 10-in water cylinders 14 ft. above the level of the dam, to a distributing reservoir 185 ft. above the pumps.

The reservoir is built in two compartments, with division wall and embankments 6 ft. high above ground level. The basins are excavated 6 ft. below ground level, and are lined with clay 18 in. thick, paved with brick and grouted with cement. Their capacity is 1,375,181 gallons.

* Copyright 1881.

Much trouble has been experienced with this reservoir, and part of its slopes and its lining have been rebuilt to stop leakage.

The distribution is by cast-iron pipe. In 1876 there were 4.26 miles in use (only ½ mile being less than 6 in. in diameter), with 40 fire hydrants and 200 taps. The consumption is not stated.

The population in 1830 was 4,800. The works cost $76,000, and are owned by the Conshohocken Gas & Water Co., of which Inwood Lakens is treasurer and secretary.

CVII.—COLUMBUS, IND.

Columbus, Ind., is on the Driftwood River, which is the easterly fork of White River, 40 miles south-east of the centre of the State. In 1870, the population being about 3,000, water-works were built by the town, taking water from the Driftwood River, the water-shed of which is of sandstone and slate, and furnishes soft water. It is pumped directly into the distribution pipe by a Holly engine, driving six piston pumps and two rotary pumps.

A wooden box sunk 5 ft. in the bed of the stream and covered with sand and gravel conveys the water to the pumps, the sides and bottom being perforated with 1½-in. holes a length of 12 ft. which is filled with clean pebbles, then perforated on the bottom only for 300 ft. and then tight for 100 ft. to the pump-well.

Distribution is by cast-iron pipe, of which 4 miles, of from 10 to 3-in. diameter, with 52 fire hydrants and 180 taps, were in use in 1876.

The population in 1880 was 4,827. To 1876 the cost of the works had been $52,000. The daily consumption is not known, and the annual revenue and expenses are not given. William Brinckley was the superintendent in 1876.

(TO BE CONTINUED.)

We are pleased to acknowledge the receipt of the Tenth Annual Report of the Board of Water Commissioners to the city of New London, Conn., from W. H. Richards, Engineer and Superintendent; a description of the water-works of Stillwater, Minn., from H. H. Harrison, Superintendent; and a copy of the Annual Reports of the city officers of the city of Paterson, N. J., for the year ending March 20, 1881, from John T. Hilton, City Surveyor.

WIND PRESSURE UPON BRIDGES.

(*Continued from page* 399.)

ROBERT FLETCHER, ASSO. A. S. C. E.—Confessedly our knowledge concerning this subject is imperfect, and we have scarcely any data or formulæ upon which we can confidently rely. The mistake of attempting to deduce conclusions as to the actual pressure of strong winds upon large stationary objects from the velocity of rotation of the arms of an anemometer, is admitted. The probability—we may almost say certainty—that the intensity of pressure on the exposed surfaces of high structures increases from below upward, throwing the center of pressure above the center of figure, has been referred to by J. B. Eads, M. A. S. C. E., in a former discussion,* and also by J. B. Francis, M. A. S. C. E., in his valuable report on the stability of the chimney of the Lawrence Manufacturing Company.† If there is any law for this increase, it must be dependent upon special and perhaps obscure conditions in each case, and it would not be an easy task to determine it. The influence of the size and form of the resisting object and of the partial vacuum shown by the eddy have also been noticed in the previous discussion. The latter condition is one of great importance.

Weisbach shows that for the pressure of moving water against an obstruction we may write, theoretically,

$$P' = Fhj + C' \frac{v^2}{2g} Fj,$$

(Mechanics of Engineering, Vol. 1, p. 1,080) in which F is the surface pressed, h the hydrostatic head, j the heaviness of the water—therefore Fhj is the hydrostatic pressure—v the velocity of impulse, C' an empirical co-efficient dependent upon the shape of the surface, and, therefore, the second term expresses the pressure due to impact. Similarly against the back surface, where the eddy occurs, the expression is $P'' = Fhj - C'' \frac{v^2}{2g} Fj$, in which C'' is an empirical co-efficient for this case. Hence for the resulting impulse we have

$$P' - P'' = P = (C' + C'') \frac{v^2}{2g} Fj.$$

He then says: "This general formula for the impulse and resistance of an unlimited stream is also applicable to the impulse of wind and to the resistance of air. Here, however, besides the difference of the aerodynamic pressures upon the front and rear surfaces, a difference in the aerostatic pressure also exists, which is due to the fact that the air at the front surface has a greater heaviness (j) in consequence of its greater tension, than that at the rear surface." Another remark is of importance in this connection: "* * * a certain quantity of air or water attaches itself to the body, the influence of which is shown by the variable motion of the body, which, *e. g.*, is very evident in the oscillations of a pendulum. The quantity of air or water which attaches itself to a sphere is 0.6 the volume of the sphere. For a prismatic body, moving in the direction of its axis, the ratio of these volumes is

$$0.13 + 0.705 \frac{\sqrt{F}}{e}$$

in which e denotes the length and F the cross-section of the body. This ratio, which was first determined by Du Buat, has been fully confirmed by the later experiments of Bessel, Sabine and Bailly." For the impulse of air and water upon a plane surface, the experiments of Du Buat and also of Thibault give $C' + C''$, or, more simply, $C = 1.86$, about two-thirds of the action being upon the front, and about one-third upon the rear surface. This was for a uniform velocity of impact. Ashbel Welch, M.A.S.C.E., in commenting* upon the experiments of Beaufoy on the resistance to prismatic bodies moving through water, infers that in air this co-efficient would be greater than Beaufoy's value, which was 2.3. But the results obtained by Du Buat, Duchemin, Newton, Borda, Hutton and others, as cited by Weisbach, for prisms and spheres in water and air, at moderate and high velocities, show no values as great as 1.5.

After all that has been done we are still left in doubt. Previous experiments generally were made on too small a scale, or under conditions otherwise not according with those with which the engineer has to deal. Hutton has given us an empirical formula which involves the inclination of the exposed (plane) surface to the direction of the wind. Is is especially applicable to roofs,† but requires us to assume a certain arbitrary intensity of horizontal wind pressure.

It is evident, then, that while theories and formulæ based upon previous experiments and observations by distinguished professional men are valuable, nevertheless we must put these in the background, and call for actual facts and data derived from careful and close observation, under conditions, usual or possible, of our practice at the present day. The paper of Mr. C. Shaler Smith is a valuable contribution, and goes far toward meeting this demand. We need a great deal more of the same kind of information, and then a thorough comparison and digest of the results embodied in the form of practical rules. But, of course, in applying results of such observations to a particular case, great care must be taken to see that the conditions correspond as nearly as possible to those occurring in connection with the results to be made use of.

I have had in view for several years past the making of systematic experiments on wind pressure, but have not yet found either time or means or suitable facilities at hand. And, indeed, no one person can generally command the means and access to all the localities necessary for the proper prosecution of such a work. Necessarily, there must be co-operation and separate experiments by a number of engineers, according to some carefully prearranged plan. I would offer the following general suggestions for such a series, leaving detail and additions to be suggested by more experienced members:

1st. A sufficient number of self-registering dynamometers should be provided for use at different points for direct and simultaneous measurement of the pressures, somewhat after the method pursued by Thomas Stevenson in his measurements of the force of the waves,* but on a much larger scale. Different series would have to be conducted for different classes of structures, as follows:

2d. Surfaces high, broad, and substantially plane, as the faces of large, high buildings, observations so as to show the variation of pressure from below upward, and both on the windward and leeward faces. The mechanism of self-registering need not be made to operate for a long time, if the instruments could be set at the beginning of a storm, and watched. In this connection, I think it would be important to observe the amount of partial vacuum at one or more points of the leeward face, which might be done with aneroid barometers.

3d. Surfaces high, narrow and substantially unbroken, as high masonry towers, chimneys, high piers, etc., observations similar to those just described. In these cases the eddy or partial vacuum on leeward side is probably more, relatively, than in the case of large buildings. The great importance of this effect may be inferred from the remarks of Robert Briggs,† M. A. S. C. E., in the former discussion, and by considering that a variation of half an inch only in the barometric pressure before and behind, means a preponderance of aerostatic pressure amounting to ½ lb. per square inch = to 36 lbs. per square foot, which is in excess of pressure due to the impact alone from a very high wind. Mr. C. Shaler Smith bears testimony to the influence of this partial vacuum in stating that nearly all the buildings he has examined in the tracks of western tornadoes appear to have blown outward. Many will remember the curious illustration of this principle shown at the Philadelphia Exposition,‡ where a ball of considerable weight was sustained on the *lower* edge of a jet of air from an air compressor, said jet having an inclination of 60 degrees to the horizontal. The partial vacuum on the leeward side of the ball, caused by the jet above the ball and a small part which passed underneath, made a preponderance of aerostatic pressure acting upward, and the resultant of this and of the force of impact was sufficient to counteract the weight.

4th. Similar observations on framed structures, as trusses and trussed towers and piers, both near the surface of the earth, and in specially high and exposed situations. In these cases it would be interesting and important to learn more certainly than we now know the shielding effect of one part of the structure upon those parts not receiving the first impact of the wind; also the amount and influence of the contraction of the stream of moving air as it passes between the parts of the truss. Probably in many structures, or behind certain parts of large frames and trusses, a very considerable degree of exhaustion of air would be observed.

5th. In some cases, during brief intervals, with enough observers working together, aneroid barometers simply might suffice to measure approximately, if not, indeed, as accurately as some other apparatus, the pressures on windward and leeward faces of structures or parts of structures.

Such a series of experiments would show the influence of height above the earth's surface, the form and size of the surface or combination of surfaces, the effect of inclination to direction of the wind, and of other conditions which would be suggested.

Manifestly, it would be necessary to have simultaneous observations of velocity, and some means of noticing the exact direction of the wind, so far as practicable.

O. CHANUTE, M. A. S. C. E.—I have heard some members ask, why if he has observed a wind pressure of 93 lbs. per square foot, Mr. Smith still thinks it safe to proportion his structures for 30 lbs. per square foot. They urge that in the course of years, at some time or another, those extreme pressures will be realized.

I apprehend that they have not clearly understood Mr. Smith's argument. Not only, as he states, are those extreme pressures limited to very narrow belts—less than the length of ordinary spans; not only would a train be blown over by a far less pressure, but it is most unlikely that a train would venture across a bridge during the prevalence of such a tornado.

In that case the exposed area, instead of being 21⅓ sq. ft. per foot lineal, for train and trusses, would be 11⅓ sq. ft., for the latter alone. Upon

* Transactions, Vol. IX., p. 395.
† See ENGINEERING NEWS, Aug. 28, 1880.

* Transactions, Vol. IX., p. 392.
†See Green's "Graphical Analysis of Roof Trusses," Chapter VI.

* See Stevenson's "Design and Construction of Harbors," Chapter IV.
† Transactions, Vol. IX., p. 398.
‡ See *Scientific American* Supplement, Vol. II., p. 728.

this a pressure of 90 lbs. per square foot would amount to 1,0.0 lbs. per lineal foot, instead of the 640 lbs. per lineal foot (estimated at 30 lbs. to the square foot) upon the bridge and train; so that if the latter strains the wind bracing 15,000 lbs. to the square inch, the tornado will strain it 24,000 lbs. to the square inch; which, as Mr. Smith says, is still within the limit of elasticity.

There are one or two additional considerations which Mr. Smith might have added to his very interesting paper, to sustain his position that our current American practice in regard to wind strains on bridges need not be essentially modified.

The following occur to me:

1. All calculations of wind pressures are assumed to be at right angles to the axis of the bridge. The resultant of this pressure is, however, I believe, in proportion to the sine of the angle which the wind makes with the surface against which it is blowing, so that inasmuch as tornadoes (which alone, as Mr. Smith has pointed out, can exceed the pressures assumed) are not likely to strike the bridge very often at right angles, the probabilities of these extreme strains being exerted are still further reduced.

2. Not only is this pressure of 30 lbs. per square foot calculated, as stated by Mr. Smith, upon "twice the vertical surface of one truss," but the usual modes of estimating this truss surface contain a still further element of safety.

Many engineers calculate this pressure upon the *developed* surface of the members of the truss, measuring around all the angles and projections, while Mr. Smith himself, as I understand from a private letter, estimates the exposed surface of *one truss*, by adding to the geometrical surface as shown on the drawings for upper chords and posts, one and a half times the surface of the ties, and twice the surface of the lower chord.

It is somewhat curious that nobody who has taken part in this discussion has yet called attention to the influence which the *form* of the bridge members has upon the resulting pressure. We all know that a convex surface presents *less* and a concave surface *more* resistance than a flat plane to the wind. I dare say that some of us have ascertained this fact experimentally with an umbrella, but I do not know that this knowledge has ever been applied to the calculation of the wind strains on bridges, or that any experiments have been made to determine the comparative resistance of various forms of bridge members.

I believe that Sir George Cayley found that a sphere offered a resistance of but 42 per cent. that of a flat plane taken through its mid section, and as the developed surface of the semi-sphere is equal to two great circles, the *average* of the pressure in that case per square foot is but 21 per cent. of what it would be upon a flat surface of equal area.

Again, an oblate spheroid of 3 diameters offers but 21 per cent. of the resistance of a plane through its mid-section, so that the *average* pressure per square foot, in that case, is but 6 or 7 per cent. of that of a plane of equal area.

The umbrella, which I mentioned a while ago, offers, I believe, a resistance of but 76 per cent. that of the plane drawn through its base, if turned with its convex side to the wind, while the concave side offers a resistance of 1.9 times that of the plane.

If we apply this knowledge to bridge members, we see at once that convex objects, like round ties and round closed columns, will offer less resistance, while trough-shaped posts and top chords will give more resistance than the plane surfaces shown upon the drawings. It is probably the general consideration of these facts which has led engineers to calculate the resistance upon a surface greater than that shown on the drawings, but it might be well to try a few experiments upon the actual wind resistance of various forms of bridge members, in order to know more accurately what is a safe allowance to make.

ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

At the regular meeting on Wednesday evening, Mr. W. E. Worthen in the chair, and Secretary Bogart having so far recovered from his recent illness as to allow him to be present, the paper read by Mr. Stauffer at the last meeting was discussed by Messrs. Chanute, J. P. Davis and Glaskin. Mr. Theo. Cooper brought forward the subject of the point of reference for bridge strains, upon which some remarks were made by Messrs. Chanute, Davis and Paine. The following gentlemen were elected members:

Alfred Brittain, Engineer City Sewerage, Montreal, Can.; Joseph R. Thomas, Engineer Williamsburgh Gas Light Company, Brooklyn, N. Y.; John A. L. Waddell, Engineer Raymond & Campbell Bridge Company, Council Bluffs, Ia.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.

The Engineers' Society of Western Pennsylvania held an adjourned meeting in the Art Gallery of Library Hall on Tuesday evening, Sept. 27, President Metcalf in the chair. The principal business of the evening was the discussion of Mr. Brown's paper on "Pittsburgh's Sewers." The gentlemen taking part in the discussion were: President Metcalf, County Engineer Davis, Mr. Brown, City Engineer Dempster and Mr. Kemp. Mr. Kemp wanted a committee appointed to receive papers from members on the question of sewer reform, the committee to select such essays as they deem most worthy. As this would be a violation of the rules of the society the Chair would not entertain the proposition. President Metcalf announced that in a short time Mr. Dempster would submit an exhaustive paper on the topic, and in the meantime provision would be made for the next two meetings. At the next meeting he would read a paper on the amount of fuel wasted and iron burned in the mills of the city, and at the November meeting Mr. Jacob Reese will read a paper on "Electricity; what is it, what it was and what may be expected of it."

ON THE PRESSURE OF WIND UPON A FIXED PLANE SURFACE.*

The recent failure of the Tay bridge and other important structures during heavy gales of wind has attracted much attention to the subject of this paper. The general solution of the problem may be thus briefly stated:

Let v = the velocity of the current in feet per second.

Let h = the height through which a heavy body must fall to produce the velocity v.

Let w = the weight in pounds of a cubic foot of the impinging fluid (for atmospheric air averaging about 0.0765 lbs.).

Let $g = 32$, the coefficient of gravity.

Then $h = \frac{v^2}{2g}$; and since p is the pressure of a fluid striking a plane perpendicularly and then escaping at right angles to its original path, is that due to twice the height h ("Daubuisson's Hydraulics," "Rouse's Experiments"), we have simply

$$p = \frac{w\,v^2}{g} =$$

(for atmospheric air)

$$= \frac{0.0765\,v^2}{32} = \left(\frac{v^2}{20}\right)$$

very nearly.

From this easily remembered formula the following table of pressures is constructed:

Velocities in		Pressure in pounds per square foot.
Feet per second.	Miles per hour.	
10	6.8	0.25
20	13 6	1.00
30	20.4	2.25
40	27.2	4.00
50	34.0	6.25
60	40.8	9.00
70	47 6	12.25
80	54.4	16.00
90	61.2	20 25
100	68.0	25.00
110	74.8	30.25
120	81 6	36.00
130	88.4	42.25
140	95.2	49.00
150	102.0	56.25

In general only these, the maximum pressures, are required; but sometimes, as in the case of the inclosed sail of a wind-mill or ship, or the roof of a building, the diminished pressure upon a surface placed obliquely to the effected current is needed; we have, then,

$$P = \left(\frac{v \sin. B^2}{20}\right)$$

in which v = absolute velocity with which the air strikes the receding plate; and B = the internal angle between the obliquely placed surface and the direction of the impinging wind.

* Paper by T. Hawksley, P. P. Inst. C. E., read before section G, British Association Meeting, York.

With regard to the phenomenon called "a gust of wind," nothing is known, either as to its cause or as to its exceptional but almost momentary velocity, or as to the extent of the area over which it temporarily operates; but it is, notwithstanding, certain that a wind pressure of even 40 lbs. on the square foot is unknown in these islands, because, as may be readily shown, the intensity of pressure would suffice to have overthrown most of the long-existing factory chimneys, to have overset post wind-mills, and to have scattered the greater number of the slighter built domestic and and other structures, which have, nevertheless, "weathered many a storm," and still remain inact.

It remains to make a passing allusion to whirlwinds, tornadoes and water-spouts, all the results of spiral motions apparently produced in some obscure manner by electrical action. These phenomena are very rarely observed to occur on an important scale in these kingdoms. The powerful forces concerned in or generated by these erratic movements have never been measured, and consequently cannot be formulated; but it may be observed that were they known they could not be introduced with propriety into calculations of the strength of structures intended to have a commercial value, because of the extreme improbability of any particular structure falling within the range of their destructive effects. They fall, in fact, within the legal category of "Actus Dei."

The conclusion of the author of this paper therefore is, that for structural calculations a maximum wind pressure of 40 lbs. per square foot may be very safely adopted, notwithstanding some common anemometrical observations to the contrary.

With regard to these observations the author remarks that the instruments in use are little better than philosophical toys, and that, in general, they afford no direct, comparable or reliable indications of either velocities or pressures; and that they are often so injudiciously placed as in many instances to record the effects of combined and, therefore, locally accelerated currents, while, in other instances, they record only the effects of obstructed and, therefore, locally extended currents.

As the acquisition of accurate data is of great and increasing importance, the author suggests that the British Association and other learned societies interested in physical investigation should unite in providing the necessary funds and observers for the purpose.

EARTHWORK SLIPS.*

The alluvial clay forming the surface deposit on the north bank of the river Tyne has some features of interest for the engineer from its great liability to slip when opened out. It is a tenacious, flaky, brown clay; the flakes, which vary from ⅛ in. to 1 in. in thickness, being separated by films of fine sand, and holding water obstinately. The upper and lighter colored bed varies from 6 to 12 ft. in thickness, and below this lies a bluer colored, more unctuous clay, similar in its flakes and partings to the browner clay above.

The lower bed is extensively worked for brick-making, requiring the addition of a more open and sandy material, but forming, when well burnt, a remarkably sound and hard brick of good color, which stands well. The brick-fields, when the clay has been removed, shows very well the slippery nature of the material, as when left for any length of time the clay is found to have gradually and continuously broken away from the face and slipped outwards, until the section resembles that shown in Fig. 1, the ultimate slope being often not less than 10 or 12 to 1 with apparently no signs of resting even at that. This is an extreme case, as the surface water is unable to get away, except by soaking down the partings, and no attempt is made to drain it off.

The Byker and Percy Main branch of the North-eastern Railway cuts chiefly through the upper or brown beds of this clay, occasionally touching and entering for a few feet into the lower or blue beds; and the principal cuttings were much disturbed by slips occurring in the same way as in the brick-fields and often disturbing the ground below the level of the formation. The usual form of these slips is shown in Fig. 2.

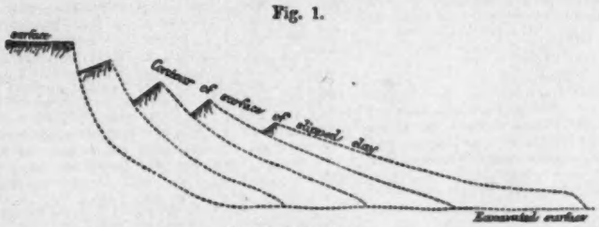
The method adopted to stop the mischief was that of burning the clay *in situ*, and it was carried out as follows, the details varying a little with the circumstances: On a decided slip occurring the first thing done was to clear away a space of 15 to 20 feet in the line of the cutting, until the solid clay was reached both downwards and sideways. A good fire was then lighted on the solid ground,

* Paper read by W. G. Laws, Mem. Inst. C. E., before the Institution of Civil Engineers, London.

using plenty of broken wood and coal, and allowed to burn up well; on to this the clay was cast from both sides, in layers varying from 12 to 30 inches, small coal being spread between, until the heap was from 8 to 12 feet high. This was allowed to burn out on the one side and continually extended on the other, as in firing a clamp of bricks. The burnt material from the cool side was then cast back as soon as possible into the void in the slope, and trimmed to shape.

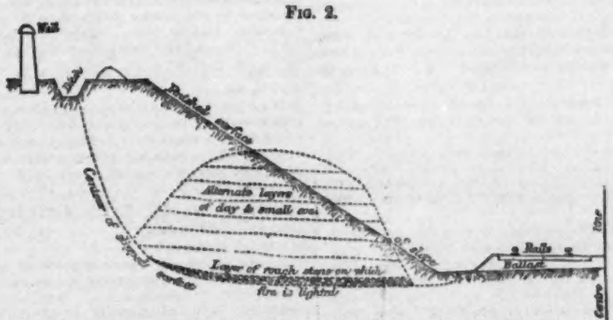
The plan adopted was generally successful, though in some of the earlier cases, from sufficient care not having been taken to get well down to the solid clay, slips occurred for a second time, when the process had to be repeated to a greater depth. It was found that a bed of heavy slag and hard stones, roughly laid on the solid ground as a bed for the fire, very much helped the process by giving a free draught. The general form and position of the heaps is shown in Fig. 2. The material when burnt occupied by estimation from 20 to 25

Fig. 1.



Section of Brick-fields.

Fig. 2.



Slips in Cuttings. Byker and Percy Main branch, North Eastern Railway.

per cent. more room than before, leaving a considerable surplus of burnt stuff to go to bank.

Where the banks had been formed of the same clay several slips also occurred, and were treated in a similar way, greater care being necessary, however, in removing the slipped material to avoid extending the mischief. The banks were therefore burned in narrower sections. This method of treating the slips was successful, but rather costly. As nearly as could be ascertained the cost of burning and replacing was from 1s. 6d. to 2s. per cubic yard of the original slip, irrespective of the increase of bulk of the burnt material. As, however, the material was never entirely removed from the site of the slip, but only cast out and back again, accurate measurements were difficult to make.

The author has had occasion to deal with the same formation of clay on the west side of Newcastle, and there adopted the plan of excavating trenches in the slipped cuttings, of from 3 to 4 ft. wide, and from 5 to 10 yards apart. These trenches were carried down to solid ground, and filled in with rough stone, and the slipped material was cast back and trimmed. A good pipe drain was carried down the side of the line deep enough to drain the foot of these trenches and prevent any lodgment of water. This plan was always successful where the trenches were not too far apart.

In forming the banks there was, fortunately, a surplus of material which was utilized by tipping the most of the clay to spoil and using only the sounder part. In one instance, however, where, from the depth of the bank and the nature of the ground, trouble was anticipated, the precaution was taken of covering the culvert at the bottom of the gully and some distance on each side with a thick layer of brush-wood, holes being left here and there in the tops of the culvert to carry off any water that might collect. The outer toe of the bank was also laid with several layers of brushwood extending across the gully and about 3 ft. in depth. This bank stood very well, and, owing to the brushwood being cut on the spot, the cost was trifling.

COST OF WATER POWER IN AMERICA.

The following notes on the cost of water in America were obtained by the Water Power Company, of Lawrence, Mass., during the progress of a suit against the city of Boston. Mr. H. F. Mills, engineer of the company, testified that $12 per day for water privilege was cheaper for the mills at Lawrence than to start their engines and use steam power. The cost of a mill power is only about $2.50 per day in Minneapolis. At Lawrence, Mass., all the mills have engines which are used as auxiliary power, and they pay $1,200 per year for their water privilege. It might be a fair general statement to say that a horse power produced by steam would cost about $50 per year more than a horse power produced by water, as demonstrated by actual comparison at Lawrence, Mass., where power is used in large quantities. A mill privilege at Minneapolis is now worth $.50 per annum, the theoretical power of which is 75-horse power. This gives a capacity of 135 barrels of flour per day. The cost per barrel at this rate is a little less than two cents per barrel, being a great saving upon the cost of grinding by steam power.

Mr. Verplank Colvin, Superintendent of the Adirondack Survey, returned to Albany on Tuesday from his camp at Black Mountain near Lake George. The work of surveying in the Adirondack wilderness has been steadily progressed during the summer. For the past month the party of operators have been stationed at Black Mountain, but they have been unable to do much work on account of the smoke from the forest fires, which has been so dense as to render observations impossible. Mr. Colvin will return to the woods in a day or two.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Randolph, N. Y., is agitating the project of a $20,000 water-works.

Work upon the extension of the water-works pipes of Toronto, Canada, into the lake, is progressing rapidly.

The New York *Commercial* says Professor Bell might now apply his "induction balance" to discovering Charley Ross.

Professor Bell's induction balance lied so like blazes that the gas companies propose to have him invent a new meter for them.—*Boston Post.*

Topeka, Kan., has contracted with Messrs. Russell & Alexander and the Holly Manufacturing Co. for the construction of water-works in that city.

The trustees of the village of Hyde Park, Cook County, Ill., have awarded the contract for their new water-works building, the price being $15,915.

The Miller Company, Canton, are perfecting some new styles of steam pumps, which will soon be offered to the attention of the public.

Records show that in 13 Septembers in the past 31 years no rain fell in San Francisco. The rain in the remaining 18 Septembers ranged from .02 of an inch to 1.03 inches.

The F. C. Wells Pump Works, of Chicago, are furnishing a water-works engine of great power (adapted for either fire or water purposes) for the Elgin National Watch Company, Elgin.

The Troy *Times* says that J. T. Fanning, a Boston hydraulic engineer, is running a line of levels for a proposed water main between Lake George and New York City. The line will probably cross the Hoosac River near Schaghticoke.

The city council of Wabash, Ind., has appointed a committe to visit a farm one mile north of the city to make an examination with a view to building water-works. It is said that wells dug on this farm will furnish an abundant supply of pure water for public use. Should the investigation result in obtaining water, extensive works will be built at once.

The Cope & Maxwell Company, Hamilton, write that the demand for all regular stock sizes of their pumps increases. They are adding plant tools and appliances to facilitate the filling of the already large number of orders on hand, and are now working, in addition to the day force, a night gang until 10 o'clock at night, and as soon as more workmen can be had they expect to run all night.

ELECTRICITY.

Nearly three thousand miles of telegraph cables have been laid underground in Germany, at an expense of £1,510,548. The first cost is high, but the expense of keeping them in repair is expected to be very trifling.

In an elaborate report to the shareholders of the Central and South American Telegraph Company, Mr. Jas. A. Scrymser, President of the company, states that contracts have been concluded for 3,082 nautical miles of submarine cable of various types, with the India Rubber, Gutta Percha and Telegraph Works Company, limited, of London. The latter company is to lay and guarantee the perfect working of these cables as a whole, and is required to guarantee that the various types of cable shall be of sufficient length, respectively, to properly connect the points required. Twenty-two miles of cable are being completed daily, and it is reported by the company's electrician to be of very superior quality. The provisions of the contract amply secure the company in every particular against loss, damage, or delay. No less than five steamers will be necessary to transport the cable and its accompanying material. The first shipment will clear from London Nov. 15, or pay a penalty of $1,000 per day for each day's delay; the other shipments will follow at fixed dates under heavy penalties for delay. The cable connecting Panama with Callao is to be completed by May, 1882, and it is expected that the whole line will be in commercial operation during the ensuing month of July. Careful estimates of cost have been made, and it is expected the company will have an ample cash surplus and $1,000,000, par value, of its stock in its treasury on closing the construction account. This result will be attained notwithstanding the fact that the company will have about 900 tons of cable more than the original estimates called for, and that it has secured the following valuable exclusive telegraphic rights not included in the original prospectus: United States of Colombia, the exclusive right covering its Pacific coast, inclusive of the Isthmus of Panama, for 25 years; Ecuador, the exclusive right for 50 years, and Peru, the exclusive right for 25 years. All of these rights have been ratified and confirmed by the respective governments, and contain other privileges highly beneficial to the company. J. B. Stearns, who has been appointed electrician and general manager of the company, has secured an experienced staff of electricians to watch over the cable in every stage of its manufacture and laying. The establishment of these cables will connect, telegraphically, the United States with Brazil, via Mexico, Guatemala, Costa Rica, Panama, Colombia, Ecuador, Peru, Bolivia, Chili, and the Argentine Republic; and their geographical position is such as will insure a large and remunerative traffic from the time of opening. This traffic is secured exclusively to the company under the protection of the valuable rights which it possesses.

STREETS, DRAINAGE, ETC.

At a meeting of the New York City Board of Estimate and Apportionment, on Sept. 30, a supplemental and reduced estimate of the amount required by the Department of Street-cleaning for the balance of 1881 was received from Commissioner Coleman. The Mayor stated that the proposed filling in of the sunken meadows at Hart's Island with ashes, and the fact that Mr. Coleman expected to sell the street-sweepings, would reduce the expenses of the department nearly $100,000 from the amount which would otherwise be required. The new estimate of Commissioner Coleman called for $251,715.05, divided as follows: Salaries, $24,406.66; wages and supplies, $194,808.39; purchase of horses, carts, harness, scows, sweeping-machines, etc., $32,500. On motion of Controller Campbell the sum required was appropriated and will be put in the tax levy for the present year. It was also provided that any portion of the $251,000 may be used by the Commissioner in paying for any work in the department he may decide to have done by contract. The law under which the Department of Street-cleaning is at present organized authorized an appropriation of $350,000 for the department this year, and the Commissioner is, therefore, almost $100,000 within the limit.

BRIDGES.

The East River bridge trustees report receipts from all sources to be $13,222,129; total expenditures, $13,166,792.

It is now said that Mr. P. A. Peterson will commence surveying for the Atlantic and Northwestern Railway Company's bridge across the St. Lawrence, near the Lachine Rapids.

The Central Bridge Company, of Buffalo, has taken the contract for the construction of the Ohio Central Railroad bridge over the Ohio River at Point Pleasant, West Virginia. The bridge will cost $750,000 and will be completed within twelve months.

Work on the Nicaragua Railway is progressing very favorably. The bridge over the Paso de Caballos is approaching completion, and will soon enable trains to run through from Corinto to Chinandega. The section from Leon to Chinandega is well in hand. Twelve miles of rails have already been laid, and the greater portion of the remainder is nearly ready for track-laying.

The Chesapeake & Ohio and Kentucky Central interests have determined on a bridge to be built within two years, from Cincinnati to Covington, for railroad purposes, with foot and wagon passages additional. Under the direction of President M. E. Ingalls, Mr. J. R. Ledyard, Engineer of the Big Four, has surveyed Johnson street, Covington, and finds that the approaches there can be made without injury to property. The foot of Elm street, Cincinnati, is now to be surveyed.

G. W. & F. Smith, South Boston, are now finishing one of the two lighthouses being built for the United States government. The one now erected is for the White Rock Light, off Beaver Tail, Narragansett Bay, where the steamer Rhode Island was lost. It is of cast iron, and consists of the foundation pier on three sections, 8 ft. high each, 40 pieces in each section. The foundation pier is filled with broken stone cement, all solid. These 120 pieces weigh 100 tons. Upon the top of the pier is a four-section lighthouse, each 8 ft. high, and one section 7 ft. high, and upon the top of this is the lantern, 6 or 7 ft. high. The whole affair is 60 ft. high above the water line. The upper part is finished with some ornamentation, and a railing is placed about the top. The plans are by Gen. J. C. Duane, engineer of the second lighthouse district. A hollow iron shaft in the center supports floors and deck; windows are provided, and the interior will be fitted up for the living rooms of the lighthouse keepers. All the work will be sent away from Boston in another week, and will be put up and ready for duty the present fall. The same parties are making another of the same kind, and from the same plans, for Stamford, Conn. The total weight of the cast iron for each of these two lighthouses will be 160 to 170 tons. They have just finished a light-house and pier for the Borden Flats, Fall River, which is now nearly erected.

RAILROADS.

Atlantic & Pacific Railway engineers report that the grade between Colorado and San Francisco will not exceed 80 ft. to the mile.

The demand for railroad iron and supplies is becoming so great that some large manufacturers are refusing to take orders for delivery earlier than next summer.

It is said that F. B. Coleman, of Fredericton, N. B., has secured the contract for building a hundred miles of the Canada Pacific west of Winnipeg.

In the *Railroad Gazette* of Sept. 9 is published an article on Railroad Signaling in England, which is accompanied by a full page of illustrations of English railroad signals.

In accordance with the recent decision of the iron masters to reduce the production of pig iron, only 105 furnaces are working in the Scottish iron works this week, against 121 last week.

According to Poor's Manual, there were 219,805 miles of railroad in the world on Jan. 1, 1880. Of this, America had 100,867; Europe, 102,593; Asia, 8,983; Africa 3,024, and Australia 4,338 miles.

SAN FRANCISCO, Sept. 30.—A dispatch from San Diego says the British ship MacMillan arrived there yesterday, in 128 days from Antwerp, by way of the Cape of Good Hope, with a cargo of steel rails.

The cheapest riding in the world is on the underground railroads of London. Some of them carry workmen 12 miles for a penny—two cents. The passengers last year numbered 110,000,000.

VICTORIA, British Columbia, Oct. 4.—The Rodgers party of syndicate engineers is now surveying the Kootenay Pass for a practicable route for the Canadian Pacific Railway, having abandoned the Howser Pass survey.

"Is this my train?" asked a traveler at the Grand Central Depot of a lounger. "I don't know," was the reply, "I see it's got the name of some railroad company on the side, and expect it belongs to them. Have you lost a train anywhere?"

NEW YORK, Oct. 3.—The Highland Junction Railroad and Bridge Company elected officers to-day. The company designs to build a road and bridge across the Hudson, thereby connecting the coal fields of Pennsylvania with the Eastern States. A route has been surveyed from Cornwall to Matteawan.

Messrs. Collins & Stevens have the contract for building the entire line of the Oregon Short Line Union Pacific Railway from Granger to Baker City, over 700 miles. The prices are not high for earth or rock. Two hundred miles, in which is a tunnel 1,650 ft. long, are now under process of construction.

The Seaboard, Pittsburgh & Great Western is the name of another company incorporated at Harrisburg to connect the Baltimore & Cumberland Valley road with Pittsburgh and also with the Reading's southwestern branch below Harrisburg. Thomas E. Shoemaker, of Philadelphia, is president and the capital stock is $2,100,000.

The contracts for the construction of the Missouri Pacific extension in Nebraska are being pushed with energy. It is reported that the new line will be graded to Omaha by the middle of October. Track-laying has been begun in several places and two or three large bridges will be completed, it is expected, by Nov. 1.

The construction of the Milwaukee & Madison branch of the Chicago, Milwaukee & St. Paul Railway is nearing completion. But twenty-four miles of track remain to be laid and track-laying "gangs" are working in both directions from Jefferson and in one direction from Madison. The officers of the company announce that the line will be ready for the rolling stock by the end of October.

A contract was executed this week between the Northern Pacific Railroad Company and the Pullman Palace Car Company, whereby the latter company is to equip all the lines of the Northern Pacific Railroad with the latest and most approved style of Pullman cars, and to operate the same on joint account with the railroad company for a period of fifteen years.

The forthcoming financial plan for the extension of the Atlantic & Pacific road will call for $15,000,000, of which $5,000,000 will be used for the construction of the line westward from Vinita through the Indian Territory. The other $10,000,000 will push the work through California towards San Francisco; 236 miles from Albuquerque, N. M., into Arizona, are already steel-railed, although the work has been impeded by Indians and floods.

A system of lighting railroad cars with gas has been tried on the Baltic Railway. The gas is made on the cars by the action of sulphuric acid and zinc, the resulting hydrogen being carburetted by being passed through naphtha vapor. It is said that the gas has very little odor, that its flame is bright, white and constant, and that it is cheaper and gives better results than stearine candles.

The discomfort of traveling in India in hot weather is decreased on the line of the great Indian Peninsular company by an ingenious device. The windows in every first-class railway carriage are provided with screens made of fragrant khas khas grass, which are kept constantly damp by mechanism connected with the wheels. By this means the air is kept sweet and comparatively cool.

A patent for another railroad in Western Wisconsin, to be known as the Chicago, Freeport & St. Paul Railway, was issued Oct. 1. The incorporators are: Wm. O. Right, of Freeport, Ill; E. Baldwin, of Cresco, Ia.; Mr. J. Briggs, Aldro Jenks and P. J. Morris, of Dodgeville. Of the capital stock of $6,000,000 the incorporators have subscribed to $100 each. The west portion of the line runs from on a south-bound air-line of the State in the town of Cadiz, Greene County, to Hudson, St. Croix County, through the following counties: Green, Lafayette, Iowa, Sauk, Juneau, Richland, Vernon, Monroe, La Crosse, Jackson, Trempealeau, Buffalo, Eau Claire, Pepin, Dunn, Pierce and St. Croix. The length of the main line is 240 miles, and of the branch, from Moscow, Green County, through Iowa, Dane, Sauk and Columbia counties, to Portage City, 40 miles.

A Frenchman has collected statistics which show that in Prussia the railways every year kill 1 passenger in every 21,500,000 whom they carry; in Belgium they kill 1 in every 9,000,000; in England, 1 in every 5,250,000, and in France, 1 in every 2,000,000. France thus stands highest for killing. For wounding it ranks second, England being first. England, as will be seen, is second for killing. It is estimated that State and company management may have something to do with these differences.

The Philadelphia street car lines are waiting the result of the wire-rope system now on trial in Chicago. If it will stand the coming winter there, it will be introduced in Philadelphia next summer. The anticipated advantages are greater speed, better accommodations, and less cost of maintenance. The pipe which contains the rope will be laid between the tracks, but will not interfere with the free public use of the street, as the grooved opening from the surface into the pipe, by which the car is attached to the rope, will be but three-quarters of an inch wide.

PHILADELPHIA, Oct. 3.—Among the rumors to-day is one to the effect that William H. Vanderbilt, in order to obtain a Western outlet from this city, is contemplating the building of a road to connect Antrim, in Tioga County, with Williamsport, the distance being about fifty miles. By this means the New York Central will, by its connection with the Wellsboro & Lawrence and the Hornellsville & Pine Creek branches, have a continuous route from its main line to Williamsport and thence by the Catawissa branch of the Reading to Philadelphia.

Mr. Charles Latimer, Chief Engineer of the New York, Pennsylvania & Ohio road, has placed on the frogs and guard rails in the Cleveland yard a new invention, called a "foot-guard." The invention consists of a flat steel spring placed in the opening, or "boot-jack" ends, of frogs and guard rails, or in any place where one's foot would be likely to be caught. This spring fills the place sufficiently to keep the foot out of it, while it will yield to the pressure of the wheel flanges, and thus avoid any risk of running the wheels off the track.

The Atlantic & Pacific Company are laying the track of their road across Arizona at the rate of one and a half to two miles per day, and have completed arrangements for extending the road to San Francisco as rapidly as abundant means and labor can accomplish it. Already shipments of steel rails are being delivered at that city, and another year will witness the opening of the third railroad across the mountain range that divides the Pacific from the Atlantic States. From St. Louis to San Francisco the road will be virtually under one harmonious control, uninfluenced by the entanglements that exist between the Union and Southern Pacific lines.

The present activity in every branch of railway supply manufacture is really wonderful. There is an immense and constantly-increasing demand for machinery and tools for the equipment of new car shops in various parts of the country, and also to replace second-rate or worn-out appliances in old shops. So great is the accumulation of orders, and the reduction of certain kinds of machinery usually kept in stock, that contracts for early delivery are not easily made. Every day confirms this state of things as respects rolling-stock construction, repair and maintenance, and is a pretty sure indication that the roads have something to do, and that they are not incurring unnecessary outlays for business yet to be developed.—*Car-Builder.*

MONTREAL, Oct. 3.—The commencement of one of the most important enterprises to the future of Montreal that has for many years been attempted was initiated to-day under the direction of the Atlantic & Western Railway. Mr. P. A. Peterson, C. E., late of the Occidental Railway, with a full staff of engineers and men, commenced the surveys and soundings for the new bridge over the St. Lawrence at Verdun, near the city. The work will be prosecuted with all the vigor possible, so that the specifications for the bridge will be ready in time for operations on the structure to commence early next spring. In addition to this, a survey under the same engineer will be made from Montreal to Smith's Falls, and a branch line constructed to the latter point so as to connect with the Canadian Pacific there. From Smith's Falls to Perth the old line of the Canada Central will be utilized, and from Perth the new Ontario & Quebec Railway now being located to Toronto. This will complete the western connection from Montreal, and will give an independent line in competition with the Grand Trunk. It will also be the shortest and most direct to Toronto from this city. Arrangements are now in progress for getting running powers over existing lines to the south, and building any links that may be necessary to the Atlantic coast, thus giving a grand through railway via Montreal from the Atlantic to the Pacific. This new enterprise—the bridges especially—is of vital importance to the commercial interests of Montreal. It will bring with it also the establishment of a monster depot and gigantic car and locomotive shops in the western section of the city, involving not only an immense ready money outlay, but permanent benefit thereafter in giving employment to hundreds of skilled mechanics. Such a vast enterprise under the auspices of the Canada Pacific Railway Company (which is a guarantee of its being carried out) should receive substantial and encouraging support from the citizens of Montreal. It will do more to give an impetus to the trade of the city than anything since the building of the Grand Trunk. At a meeting held here the following permanent directors were appointed: Messrs. George Stephen, Duncan McIntyre, President and Vice-President Canada Pacific Railway, Hon. Bradley Barlow, Southeastern Railway, Hon. R. Thibaudeau, Hon. Peter Mitchell, Hon. J. J. C. Abbott, C. C. Colby, A. B. Chaffee and J. Kimball, New York. Mr. McIntyre was appointed President, and A. B. Chaffee Vice-President. A call of ten per cent. was made on the capital and subscribed on the spot by the shareholders present. Full instructions were given to Mr. Peterson to prosecute the surveys and procure all necessary boats for the soundings in the river.

NEW PROJECTS.

The Brazos, Mound City & Northern Railroad, capital $1,500,000, filed a charter in the State Department of Texas, Sept. 30. The proposed line of the road, which will be constructed at once, commences at the mouth of the Brazos River and extends through the counties of Brazoria, Fort Bend and Waller to Hempstead, Waller County, a distance of about 125 miles.

HARRISBURG, Pa., Oct. 2.—A charter has been granted by Governor Hoyt to the Seaboard, Pittsburgh & Great Western Railroad, which proposes the construction of a road from points on the Baltimore & Cumberland Valley road, in Franklin County, to points on the Ohio River, in Alleghany County. The capital stock of the company is $2,100,000. The length of the road will be 210 miles. The president is Thomas E. Shoemaker, of Philadelphia, and all of the directors are from that city. By this route and connections it is proposed to ship grain cheaper than it is now carried to Eastern markets.

Rapid progress in steam navigation on other waters than the Atlantic is being made by English ships. One of the Pacific Navigation Company's royal mail steamers has just reached Plymouth from Adelaide, in South Australia, after a voyage which included all stops—one of them being two days in the Suez Canal—of 35 days and 3 hours. She crossed the Indian Ocean from Adelaide to the Red Sea, in 18 days, during which she made 322 knots consecutively each day, showing that she steamed 5,800 miles at the rate of 13¼ knots an hour. The ship, which is named the Cotopaxi, is not a new one. She was built nine years ago.